

Laparoscopic Pancreaticoduodenectomy to Treat Cancer of the Ampulla of Vater

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ABSTRACT

Objectives: We explored the feasibility, difficulty, and indications for laparoscopic pancreaticoduodenectomy.

Methods: Since November 11, 2002, we have successfully completed 5 laparoscopic pancreaticoduodenectomies. Patients included 4 males and 1 female, average age 43 years. Three patients had duodenal papillary cancer, one had cancer of the head of the pancreas, and one had pancreatic mixed cancer (duodenal papillary cancer, hepatobiliary ductal adenocarcinoma). The average mass size was 1.5/1.8 cm to 2.6/2.5 cm.

Results: The pathology diagnosis was well-differentiated duodenum papillary adenocarcinoma in 3 patients, head of pancreas endocrine small cell carcinoma in 1, and duodenum papillary adenoma with malignancy ductal intermediate differentiation adenocarcinoma in 1. During surgery, average blood loss was 770 mL. Operation time averaged 528 minutes. The main difficulties during surgery were estimation and identification of pancreatoduodenal tumor resection and hepatoduodenal ligament venation changes. After surgery, 1 patient had a small amount of pancreatic leakage, another developed stress ulcer bleeding; both patients became normal after appropriate treatment. The fourth patient developed severe recurrence of pancreatitis with pneumonia and on the 39th day after surgery developed stress ulcer bleeding. This patient died during the second operation.

Conclusion: Laparoscopic pancreaticoduodenectomy is a very difficult and risky operation. It requires ample clinical experience in traditional pancreaticoduodenectomy, perfect laparoscopic surgery technique, consultation and cooperate with the surgical team, updated laparoscopy equipment, and very strict surgical indications. For hospitals that meet the above conditions and require-

ments, laparoscopic pancreaticoduodenectomy is very safe and feasible.

Key Words: Ampulla of Vater, Laparoscopic pancreaticoduodenectomy.

INTRODUCTION

Pancreaticoduodenectomy is the treatment of choice for operable malignant tumors of the ampulla of Vater, the lower end of the common bile duct, the duodenum, and the periampullary region of the head of the pancreas. For this group of patients, the operation has an acceptable mortality and offers a good chance of long-term survival. Less favorable results, however, have been reported in patients with more extensive carcinomas of the head of the pancreas, in some older patients, and in some patients with complex disease.

Gagner et al¹ reported 10 cases of Whipple surgery performed with a laparoscope. However, this technique has not yet been reported in China. Herein, we report a case in which we successfully performed laparoscopic pancreaticoduodenectomy.

CASE REPORT

A 64-year-old man was admitted to the hospital complaining of upper abdominal pain. Cholangiectasis and suspected choledocholithiasis were found on ultrasonographic examination. A 2.0x2.5 cm papilla glandular tumor with a large base and friable parenchyma was found by gastroduodenoscopy. Pathologic examination indicated duodenal cancer. Magnetic resonance imaging showed that the distal choledochus had become beak shaped. The ultrasonography and computed tomography examination showed cholangiectasis (diameter 1.5 cm), a distended pancreatic duct, and a gallbladder polyp. There was no evidence of extensive invasion and metastasis.

Physical Examination

No jaundice was present. Cardiopulmonary function was normal. The laboratory test results revealed the following:

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total bilirubin 15.6 $\mu\text{mol/L}$; direct bilirubin 6.0 $\mu\text{mol/L}$; total protein 51.4 g/L; ALT 54 U/L; AST 58 U/L; and ALP 137 U/L. Kidney function, routine blood examination, and prothrombin time were normal. After effective preoperation preparation of the patient, pancreaticoduodenectomy was performed with laparoscopic means.

Operative Procedure

The patient was placed on the operating table in supine position with his legs separated. A laparoscope was inserted through an incision in the inferior border of the umbilicus. Four additional incisions (0.5 cm, 1.0 cm, 1.5 cm, and 0.5 cm) were made for trocar placement in the right and left midclavicular line at the inferior-coastal and umbilical levels. The pelvic cavity and abdominal organ surfaces, including the liver and gastrocolic ligament were inspected. No signs of metastasis were found. The hepatic ligament of the colon was divided to mobilize the hepatic flexure and right transverse colon in a medial and downward direction to expose the duodenum and head of the pancreas. A laparoscopic ultrasound probe was used to screen the pancreas, duodenum, and bile duct. We failed to demonstrate any local or metastatic spread of the tumor, in particular any extension into the vena cava, portal vein, superior mesenteric vein, or root of the transverse mesocolon. From above, forceps were inserted through the trocar in the right abdomen and were used to gently open the plane between the pancreas and the anterior surface of the portal vein. Similarly, through the left abdominal trocar sites, the space between the pancreas and the front of the superior mesenteric vein was opened. The instruments met and were utilized to separate the pancreas from the uninvolved vessels. The pancreaticoduodenectomy could then be carried out.

First Operative Stage

The duodenum was retracted and manipulated with intestinal forceps. The duodenum was freed from its mesenteric origin near the vessel root with an Ultracision harmonic scalpel and forceps. Dissection was directed toward the duodenojejunal flexure. The transverse colon and the greater omentum were retracted downward, and the ligament of Treitz and upper jejunum were exposed. The upper jejunal mesentery was divided to mobilize the upper jejunum. The jejunum was ligated with 2 ligatures and cut with the Ultracision instrument. The mesenteric vessel root was pulled toward the right, the Treitz ligament was incised, and the vessels around the upper jejunum were mobilized completely. The mesenteric vessel root was retracted toward the left, the vessels were in-

cised, and the tissue around the duodenojejunum flexure, the third part of the duodenum and the upper jejunum, were drawn out from the posterior mesenteric vessel root.

Second Operative Stage

The stomach was grasped and lifted with intestinal forceps. The hepatogastric ligament was divided, and the smaller omentum was divided below the stomach and the pylorus. The pylorus was cut between 2 ligatures with the Ultracision instrument.

Third Operative Stage

The common bile duct was incised with the Ultracision instrument at its upper portion after the portal vein, and common hepatic arteries were mobilized. Excess bile was removed by suction. An emptied and collapsed gallbladder and bile duct occupy much less space in the upper abdomen, and this makes the rest of the operation a little easier. After division of the bile duct, the proximal end of the bile duct was ligated with silk suture.

Fourth Operative Stage

The pylorus and the first part of the duodenum were retracted to expose the head and body of the pancreas to the left of the portal vein. The superior mesenteric artery was mobilized from the retroperitoneal tissues with the Ultracision instrument. The Ultracision instrument was used to grasp and lift the pancreas, positioning the device behind the neck of the pancreas and transecting it. A dilated pancreatic duct was encountered, and retained fluid was removed by suction. The distal pancreas was ligated with silk to prevent bleeding and leakage. The mass to be removed was then attached only by small vessels that pass between the duodenum and uncinate process and the superior mesenteric vessels. The largest of these is the inferior pancreaticoduodenal artery running from the superior mesenteric artery in the groove between the head of the pancreas and the duodenum. The mobilized duodenum, the upper jejunum, and the head of the pancreas were retracted toward the right and down to expose the uncinate process of the pancreas, after the groove was secured and divided between the superior mesenteric vein and the uncinate process of the pancreas. The tumor was put into an endo bag and removed through an incision in the right upper abdomen. Cholecystectomy was completed through this incision.

The last stage of the operation was reconstruction according to Child's method in which the first step was anastomosis of the pancreas to the jejunum. It was performed

according to the banding and ligation method reported by Peng et al.² The upper jejunum was brought up behind the colon and pulled out from a 5-cm incision. The jejunal mucosa was turned over and cauterized to destroy mucosal cells. After the mucosa wound was made, the upper jejunum was returned to the abdomen. A small incision was made in the jejunum, 5 cm from the upper end, in preparation for cholangiojejunostomy. Sponge forceps were positioned through the incision to pull the distal body of the pancreas into the jejunal cavity. Jejunal mucosa was positioned around the distal body of the pancreas. The jejunum-surrounded pancreas was secured with #7 silk. The front of the hook up of jejunum and pancreas was sutured with silk to prevent slippage and leakage. The cholangiojejunostomy and gastrojejunostomy were performed as in open pancreaticoduodenectomy. Suction drains were positioned close to the biliary and pancreatic anastomosis and the abdomen closed in layers.

RESULTS

The operation lasted about 10 hours and operative blood loss was 300 mL. The patient's vital signs were stable during the operation, and bowel sounds returned 2 days after surgery. The patient's temperature ranged from 38° to 39° in the postoperative period. A pancreatic fistula occurred on the fourth day, and total fluid drainage reached 800 mL. Fluid drainage decreased day by day and at 12 days stopped. Some fluid was present in the chest and was absorbed after 12 days. The liver functions were as follows: the first time total bilirubin, direct bilirubin, total protein, albumin, ALT, and AST were 22.1 $\mu\text{mol/L}$, 4.5 $\mu\text{mol/L}$, 43 g/L, 23 g/L, 37 U/L, and 102 UL, respectively. After 2 weeks, liver functions studies had returned to normal and the patient was discharged. The patient has been followed up for 10 months without any evidence of recurrence and lives normally.

DISCUSSION

The pancreaticoduodenectomy procedure has undergone a lot of change in clinical practice. Now the "Child" and "Whipple" approaches are widely utilized. However, the anatomy of this region is complex, and the traditional open operation requires a 20-cm incision for the abdomen to be clearly exposed. Because of severe operative trauma, patients often complain of serious postoperative pain. About 25% of patients develop significant complications, the most serious being related to disruption of the pancreaticojejunal anastomosis. The overall incidence of

pancreatic fistula is about 15%. Postoperative hemorrhage may occur from the gastrointestinal tract as a result of stomach ulceration, erosion in the stomach remnant, or from the operative site as a result of the corrosive effect of leaking pancreatic fluid on local blood vessels. Postoperative renal failure in jaundiced patients, diabetes, and intraabdominal sepsis may occur and result in death in some patients. Therefore, a new operative method is needed to decrease injury to patients.

Laparoscopic techniques can be used in many operations with the benefits of minimally invasive techniques. We explored this idea and show it to be a reasonable option. This operation has some difficulties, but we successfully overcame them as follows:

1. Resection of the duodenum: The duodenum, which was initially suspended between dorsal and central mesenteries, also rotates so that the second portion of the duodenum becomes retroperitoneal and encompasses the head of the pancreas in its C loop. It is adjacent to the kidney, inferior vena cava, abdominal aorta, and so on. Resection of the duodenum is difficult. First, we grasped the upper duodenum and lifted it up with intestinal forceps, drew down the right colon with another forceps to expose the tissue around the entire duodenum. The tissue around the duodenum was incised with the Ultracision device over the upper part of the duodenum to mobilize it. Drawing the mesenteric vessel root toward the right or left can expose the junction of the duodenum and jejunum to prevent injury to important vessels that induce postoperative bleeding.

2. Resection of the pancreas: The pancreas is friable and has numerous blood vessels. In open surgery, a Kocher dissector is positioned behind the neck of the pancreas and the gland divided between hemostatic stay sutures. This is not possible in a laparoscopic operation. How is it treated? We incised it transversally directly with Ultracision, and our results suggest that this technique is safe. Before the pancreas is incised, the portal vein and vessels of the spleen must be identified to prevent injury to them. The pancreatic duct is ligated with #7 silk.

3. The groove between the superior mesenteric vein and the uncinate process of the pancreas treatment: Many vessels are at the head of the pancreas and are always adjacent to portal veins. The groove is so narrow that it is called "a danger triangle" in laparotomy. Because of the magnifying function of the laparoscope, we found that the tissue and vessels can be clearly divided. After drawing the neck of the pancreas toward the right, we were suc-

cessfully able to divide and incise the vessel between the head of the pancreas and portal veins.

4. Reconstruction of the digestive tract: According to the Child approach. A pancreaticojejunostomy must be constructed by suturing pancreas to the seromuscular layer of the jejunum. The posterior part of this suture line is difficult to complete laparoscopically. Risk of vessel injury is present. The banding and ligating method of Peng et al² does not require suturing of the posterior part of the pancreaticojejunostomy and is easy and simple with laparoscopy. One must remember that the jejunum extends to the extraperitoneum, and the terminal end is turned out and its mucosa cauterized so that adhesions will be produced between the jejunum and pancreas. Grasping the pancreas through the cavity of the jejunum is another important step. The choledochojejunostomy and gastrojejunostomy can be performed laparoscopically or through a small incision as in open surgery through which the tumor is removed.

Pancreaticoduodenectomy is a complex operation in general surgery. If it is performed with a laparoscope, case selection is important; moreover, this operation should only be attempted by surgeons who have extensive experience in open pancreatoduodenectomy surgery and who have acquired the necessary advanced laparoscopic skills. If difficulty arises during surgery, we must convert to laparotomy to avoid an accident.

CONCLUSION

Many authors believe that the distal pancreatic resection with the laparoscope is entirely possible and effective; however, because pancreaticoduodenectomy requires a long operative time, can have multiple complications and a high death rate, several authors don't advocate doing this operation with a laparoscope.^{1,3,4} We think no difference exists between laparotomy and laparoscopy with regards to intraoperative bleeding and postoperation recovery; however, laparoscopy causes less pain and requires a small incision. We believe that the performance of minimally invasive surgery will increase in the future because of accompanying technological advances and technical refinements in laparoscopic instruments.

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